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ABSTRACT

The commonest context for the use of word processors with primary school children is collaborative small group work. The two major reasons for this organizational decision are resource-based (i.e. due to the scarcity of computers in the classroom) and educational, stemming from an increased use of cooperative learning methods. In order to improve the quality of children's collaborative work at the word processor, it is important that some attention is paid to the nature of their interactions during the writing process. Such interactions can reveal important information about writing and learning processes and about the impact of the computer. In this paper we shall present and illustrate a newly developed analytic method, based on functional analysis, which can be used to investigate the nature of children's verbal interactions during the collaborative writing process at the computer. The theoretical framework of the method will be briefly described and located in socio-culturally based ideas of learning. Possible applications of the analysis method will then be discussed and a possible agenda for research outlined. Contains 42 references. (Author/RS)

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Analysing interactions during collaborative writing with the computer: an innovative methodology

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Abstract

The commonest context for the use of word processors with primary school children is collaborative small group work. The two major reasons for this organisational decision are resource-based (i.e. due to the scarcity of computers in the classroom) and educational, stemming from an increased use of cooperative learning methods. In order to improve the quality of children's collaborative work at the word processor, it is important that some attention is paid to the nature of their interactions during the writing process. Such interactions can reveal important information about writing and learning processes and about the impact of the computer. In this paper we shall present and illustrate a newly developed analytic method, based on functional analysis, which can be used to investigate the nature of children's verbal interactions during the collaborative writing process at the computer. The theoretical framework of the method will be briefly described and located in socio-culturally based ideas of learning. Possible applications of the analysis method will then be discussed and a possible agenda for research outlined.

Introduction

Word processors are often used in primary schools by small groups of pupils. Although the reason for this organisational arrangement has been partly the scarcity of computers in classrooms, the cognitive and social gains related to cooperative learning methods have played a major role in increasing collaborative writing with computers. A number of studies have shown that the use of computers and cooperative learning methods in the school affects the roles of a teacher and pupils (Cohen, 1994; Mercer & Fisher, 1993; Fish & Feldman, 1989). In these classrooms the teacher has been able to step back and take the role of a facilitator of children's learning. Pupils, on the other hand, have been able to take more control over their working and learning. Although this shift in roles appears to have given pupils more opportunities to learn, it has also increased their responsibilities. It is now the task of educators to help pupils manage this responsibility. In collaborative writing, and cooperative learning in general, discourse is the means through which interpersonal meanings are established. It is through discourse that children construct their knowledge, express their opinions, values and feelings. Verbal communication which takes place during collaborative writing with word processors can, therefore, provide important

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information about the processes of children's learning and about the effects of the computer context. It is actually through discourse that educators can observer the quality and direction of their pupils' working and learning. Ideas about the significant role of verbal interaction as a facilitator of learning draw heavily on socio-cultural theories (e.g. Bruner, 1990; Harré, 1984; Wertsch, 1991; Vygotsky, 1962, 1978). Among the key tenets of this theoretical perspective are the following:

- Learning is highly social and culturally embedded;
- The development of semiotic mediational means, of which language is an important aspect, is a vital means through which humans construct and internalise resources in culture;
- Learning is the collaborative construction of a shared knowledge through contextualized discourse;
- Learning which occurs in social interaction proceeds from the interpsychological plane to the intrapsychological plane with the assistance of knowledgeable members of the culture.

Although recent developments in socio-cultural theory have brought more understanding about the processes of learning in classroom discourse (Bornstein & Bruner, 1989; Newman, Griffin & Cole, 1989; Palincsar, 1986; Wells, 1994), there are areas which need further clarification. For example, we still lack evidence of the ways in which pupils' talk functions as a means of learning in collaborative learning situations (i.e. in intermental plane) and how it is related to pupils' intramental level of functioning. Moreover, not enough consideration has been paid to the relationship between the nature of pupil discourse and the social context and conditions in which occurs. Part of the difficulty of research into these issues has been methodological: we have lacked appropriate analytical tools for the investigation of children's verbal interactions in classroom settings. In this paper we shall present and illustrate a newly developed analytic method, based on functional analysis, which can be used to investigate the nature of children's verbal interaction during the collaborative writing process at the computer. The theoretical framework of the method will be briefly described and located in socio-culturally based ideas of learning. Finally, the analysis method will be evaluated and its possible research applications outlined.

Theoretical background

Despite a recent emphasis on cooperative learning, the literature shows that systems designed to analyse classroom talk have been, for the most part, developed for examining teachers' and pupils' talk during whole class teaching (see e.g. Delamont, 1976; Sinclair & Coulthard, 1975; Bellack, et al, 1966). Methods aimed at understanding peer discourse, particularly in small group work learning, are more limited in number (Young, Arnold & Watson, 1987). The methodological approaches used for analysing peer interaction at computers appear to have varied between studies. On the one hand, categorising systems have been used for investigating pupil talk (e.g. Dickinson, 1986; Hill & Browne, 1988).

On the other hand, pupil interaction has been studied with interpretative methods without a systematic means of coding (e.g. Nastasi & Clements, 1992; Anderson, Tolmie, McAteer & Demissie, 1993; Mercer, Phillips & Somekh, 1991; Mercer & Fisher, 1993). Although heavily interpretative forms of research can be suitable for certain research objectives by giving in depth and rich information about the nature of peer interaction, this form of analysis automatically decreases the external validity of the findings. Studies aimed at understanding the ways in which pupil talk functions as a means of learning across computer and other educational learning contexts may not profit from very qualitative forms of analysis. Instead, a method which uses more systematic means of coding may be more usable. This enables comparisons to be made between the nature of peer discourse and the contexts where discourse is produced. It should be recognised, however, that every method of analysis aimed at investigating as rich data as classroom interaction has evidently its own limitations. If a study is interested in the uses for which pupils put their talk in classroom discourse, and in the relationship between the nature of interaction and the context in which it occurs, a method which classifies children's talk according to functions appears to be among the most suitable approaches. This is called a functional analysis (Young, et al, 1987). In the following the basic ideas of the functional approach to language are introduced and their relationship with the socio-cultural approach discussed. The functional approach to language begins by recognising its social nature, that its structures have been shaped by co-ordinating purposes and that it has developed in human societies as a potential for making meaning within different social settings (Halliday & Hasan, 1989). In the light of this approach text (oral / written) is both a process and product, a social exchange of meanings. On the one hand, text is a process since participants in social interaction have to make semantic choices. On the other hand, text is also a product in the sense that is an output. This, in fact, makes the investigations of the meanings of language possible. Viewing language as a socio semiotic tool, the functional approach regards the meanings of language as covering Ideational, Interpersonal and Textual aspects which are all embedded in the individual, social and cultural contexts. The Ideational metafunction which consists of the experiential and logical functions (e.g. cognitive aspects) is seen as specifying the available options in meaning. The Interpersonal metafunction is, on the other hand, viewed as conveying information about personal and social relationships whereas the Textual component facilitates the meaning potential to be connected with linguistic structure. The functional approach to language emphasises the relationship between social environment and the functional organisation of language (Halliday & Hasan, 1989). In fact, it regards the relationship between text and context as a dialectical one: the text creates the context as much as the context creates the text. To make the investigations of the relationship between the text and the context of situation possible this approach introduces three features. The field of discourse reveals information about what is happening in interaction. The tenor of discourse covers information about the participants (e.g. roles, statuses, social relationships). The mode of discourse, on the other hand, covers information about the role of language in interaction (e.g. what functions does language serve in context ?, Is it spoken, written or both ?, What is being achieved by the use of language and particular functions ?, What is the status given to the language ?). It is these three aspects which should be taken into consideration when investigating the meanings and purposes for which language is used in socio-cultural

The functions of language in the light of a socio-cultural approach

An interest in ways in which a growing child uses language as a tool for expressing meanings and intentions in culture appears to be common to both functional approaches to language and socio-cultural theories of development. Vygotsky (1962), investigating the relationship between language and thought, found the unit of verbal thought in word meaning. He saw the meaning of a word representing a close relationship of thought and speech. In regarding word meaning as a unit of generalising thought Vygotsky also sees it as a unit of social interchange. Thus, for him, a word meaning is a unit that covers both the intellectual and social functions. Also Halliday (1978,1984) in his systemic functional theory of language sees talk as a semiotic tool which simultaneously covers cognitive and social features. For him, the ideational metafunction encode aspects of the speaker's experience whereas the interpersonal semantic metafunction encode the speaker's relation to other participants of interaction. The functional approach to language and socio-culturally based ideas of learning also recognise the situation and culturally specific nature of interaction and learning. Moreover, both approaches recognise that different social structures and contexts affect the nature of interaction and the ways in which language is used (Vygotsky, 1978; Halliday & Hasan, 1989). In developing the ideas of socio-cultural theory, Wertsch (1991) addresses the issue of the organisation of "mediational means" in a dominance hierarchy in terms of the notion "privileging". It refers to mediational means, such as a certain social language, which can be viewed as being more appropriate or more efficacious than others in particular socio-cultural settings. In his writings Wertsch recognises that there exist different types of verbal thinking. Thus a fundamental characteristic of human activity is in the existence of a variety of qualitatively different forms of representing and acting in the world. The different forms of acting can be found in the heterogeneity of using language. For Wertsch, the heterogeneity of using language is not a simple issue of higher versus lower levels. Instead, his ideas hold that different speech genres are suited for different social contexts or spheres of life (e.g. "privileging"). In consequence, Wertsch sees one of the fundamental processes of development in mastering the ability to use various social languages and speech genres. For him, the process of socialisation is not one of replacing one speech genre with another. Instead, it is one of differentiating and adding to speech genres. It is a case of "heterogeneity despite genetic hierarchy" (Wertsch, 1991). To characterise the heterogeneity of children's use of oral language during conversations in different socio-cultural contexts, also in educational learning environments, a number of researchers have distinguished different speech genres, or registers, within children's talk. Although their aims for investigating children's talk have varied, there exist marked similarities between them. This similarity can be found in the distinction made between concrete and abstract uses of language in which the latter is believed to reflect children's ability to use their language in context free ways whereas the former is seen as being more context bound. For example, Basil Bernstein (1972) refers to elaborated and restricted codes of talk and James Britton (1972) talks about displaced versus embedded speech. Other

researchers who have divided children's talk into more specific functions seem also to agree with this simple categorisation (see e.g. Tough, 1973; Phillips, 1985, 1990; Barnes & Todd, 1977). For example, monitoring or commenting upon action is regarded as being one of the simpler functions (e.g. context-bound talk) if compared to explaining or reasoning about the relationships that can exist between the various components (e.g. abstract talk). The explanation for the low level of cognitive gain is considered to be in that although children are making commentaries on what is happening this does not necessarily mean that they are thinking about the problems and possibilities. Neither does this mean that children are sharing any of their thoughts. This is seen as discouraging long term planning and reflective thought (Phillips, 1985). One of the most important tasks of education has been to make children aware of the different language genres, oral or written, which exist in the culture and to create learning situations which enable pupils to use their talk as a full resource for learning. In the socio-cultural contexts of classrooms the ability to use exploratory and argumentative language modes appears to be highly valued in contrast to procedural and context specific interaction (Cohen,1994). This is, because this form of interaction is considered to encourage the development of children's higher order thinking skills. It should be recognised, however, that before the value of different uses of language to the development of children's thinking and learning is fully understood, more research needs to be done both at theoretical and practical level.

The Functional Analysis of Children's Classroom Talk (FACCT) System

The functional analysis system we have been developing was originally designed by Fourlas (1988) to investigate children's role as communicators in the teacher-centred and peer group-centred classrooms. When reviewing earlier literature Fourlas noted that most of the functional analysis systems developed for educational purposes had been designed to study children's functional development of oral language rather than to understand the ways in which discourse is used as a means of learning in educational contexts (see e.g. Halliday, 1973, 1975; Tough, 1973, 1977, 1984; Phillips, 1985, 1988, 1990). Furthermore, there appeared to be few discourse analysis systems applicable to analyse children's use of language functions during both teacher-centred and peer group-centred lessons. In his study Fourlas recorded the verbal interactions of Greek primary children during whole class and small group lessons. The lessons the children were attending to during the investigation were first language and environmental studies lessons. After audio recording children's oral language interactions and transcribing the tapes Fourlas tried to identify all the functions which occurred in the children's talk, using his knowledge of the contexts in which this talk was produced. Sixteen individual functions were detected, subsequently labelled as the Intentional, Responsive, Reproductional, Interrogative, Experiential, Informative, Judgemental, Hypothetical, Argumentational, Affectional, Compositional, Organisational, Expositional, External thinking, Imaginative and Heuristic. The Reproductional, Informative and Compositional functions were each further divided into two sub-functions.

In the following, the functions identified in the system will be described.

1. Intentional (IN)

   The Intentional function indicates an intention to speak. In addition, it can imply that a child wants to continue speaking and does not want to be interrupted.

2. Responsive (R)

   Talk used in this function respond to a question or statement. The use of the Responsive function also indicates the ways in which flows of speech are connected together. Usually this function is accompanied by other functions in the same language utterance.

3. Reproductional (RP)

   The Reproductional function includes two sub-functions. The first involves the reading aloud of a text. This can be connected with children's own text production, with the use of other resources or it can stem from the word processing software itself. The second sub-function involves the repetition of what has been recently said by another person.

4. Interrogative (Q)

   Questions either requiring information or social approval were classified as belonging to the Interrogative function of oral language.

   There are certain features that can help in distinguishing the Interrogative function in children's language. These are the use of certain words such as "why, "when" and "how", the use of "do" in front of a sentence like " Do you like skiing ?" and also intonation and word order. arnes & Todd (1977) argue that in certain language utterances questions can be recognised on the basis of intuitive knowledge acquired through the context of discussion. This type of knowledge is seen by them as being only available to the participants of the conversation and to the observer who is present whilst the discussion is taking place. This illustrates the important role of the observer in analysing and understanding the nature of children's oral language interactions.

5. Expositional (EXPO)

   Talk used to accompany a demonstration of a phenomenon or an experiment belongs to the Expositional function. Words like "this", "that", "here", "there" occur often in children's talk during the use of this function.

6. Heuristic (HE)

   The Heuristic function is used by children to express having found out something. This can relate to the current situation or to children's own thoughts and ideas. The intonation in children's talk is usually surprised during the use of this function.

7. Experiential (E)

   This function of oral language is used for expressing personal experiences. These are often related to children's families or personal lives at home or school.

8. Affectional (AF)

   The Affectional function concerns the expression of personal feelings and emotions. It can arise from surprise, admiration, pleasure, amazement, disappointment, happiness, indignation and even fear, to mention but a few. Intonation is often a strong indicator of the use of this function.

9. Informative (I)

When a child is using speech as a means of providing information, his/her oral language serves the Informative function. This function can be divided into two sub-functions involving:

- Giving information from the resources children have under their control
- Giving information based on children's knowledge, interpretations, personal opinions or ideas.

10. Judgemental (J)

The Judgemental function expresses agreement or disagreement. This can concern ideas, opinions, information or children's actions.

11. Argumentational (ARG)

The Argumentational function is closely connected with the use of the Judgemental function and indicates children's support of their judgements. It may be indicated by the use of causal connectives (e.g. but, so...), or it may not be indicated lexically but pragmatically (see e.g. James' utterances below)

12. Hypothetical (HY)

A child providing ideas or suggestions that are used as a basis for further investigation is using the Hypothetical function. Words like "if", "maybe", "suppose" or phrases like "what about" quite often characterise the use of this function. Syntactically, the Hypothetical function may be characterised by modal verb phrases (e.g. it would be easier) which indicate a hypothetical situation.

13. Compositional (C)

The Compositional function of oral language is divided into two sub-functions: dictating words to be written and revising what has been said or written.

14. Organisational (OR)

Speech used for organising work or controlling behaviour is classed as Organisational. The Organisational function often belongs grammatically to the imperative mood.

15. External Thinking (ET)

When the child is working at a task she/he may sometimes think aloud. This kind of language use is very seldom addressed to anyone in particular and language utterances carrying this function can easily sound incomplete since sometimes only a part of children's thoughts are expressed in speech. The child may also make stops and starts or just make sounds not regarded as words, like "...er..." and "...hmm...". Thus utterances indicating the use of the External thinking function do not always follow the conventional syntax of sentences.

16. Imaginative (IM)

A child introducing or expressing imaginative situations is using the Imaginative function.

Further development of the system

The classification system devised by Fourlas (1988) was later applied in a study by Kumpulainen (1994) of the oral language interactions between groups of children using computers. The aim of the study was to investigate primary school children's writing and learning processes as indictaed by their verbal interactions during the process of collaborative writing with the computer. The study also aimed at investigating the association of features such as attainment grouping, gender and the use of the keyboard with children's oral language interactions in the computer context. The study was cross-cultural and it involved children from Finland and the U.K. During the data collection the children's verbal interactions were audio taped. The audio tapes were transcribed verbatim and supplemented by field notes from observations and informal interviews. The functional analysis system was then applied to the transcripts. As a result of this study the system was modified slightly, as will be described below.

The use of the Compositional function

In the original classification system the Compositional function was divided into two sub-functions; Revising and Dictating writing. In the Kumpulainen study, however, perhaps because the focus of study was specifically upon children writing together using the word processor, it was noted that children frequently used their talk to create writing. Thus a third sub-function was included in the Compositional function, that of talk used for the creation of writing.

The use of the Interrogative function

In the system used by Fourlas the Interrogative function did not include any sub-functions. Yet, in the Kumpulainen study it appeared that two kinds of questions were occurring in the children's talk. On one hand, there were questions asking for information based on the children's knowledge or opinions and on the other, there were questions that were looking for social acceptance or encouragement. While the former type of question was usually followed by a wait for a response, it appeared that replies did not necessary occur when questions were of the social kind.

The use of the Responsive function

In the original system language use that provided factual information in response to a question was coded as Responsive function. Yet, answers which carried information about "children's personal experience, personal opinion, descriptions or information important for the development of children's tasks" were placed into other categories than Responsive (Fourlas, 1988, pp. 55). For the Kumpulainen study it was decided, however, that talk which was used to give a reply to a question would automatically be coded as the Responsive function. By classifying responses in this way, the study was able to compare the relationship between the number and nature of children's questions and replies.

The use of the Informative function

The Informative function was originally divided into two sub-functions: the giving of information based on children's knowledge or opinions and the giving of information from the resources children had under their control. It appeared, however, that talk used for giving information which was closely connected with the current situation did not fall into either of these two sub-functions. In consequence, it was necessary to add a third sub-function relating to this situational information.

Evaluating the system

The studies in which the functional analysis system has been used so far (Fourlas, 1988; Kumpulainen, 1994) imply that the method is, in general, applicable to analyse the functions of pupil discourse cross-culturally and across learning contexts, particularly during collaborative writing with computers. It seems worthwhile, however, that the method should be first piloted and possibly revised into more context specific forms to meet the aims and purposes of particular research investigations. To understand the functions for which peer discourse is used, it also is necessary that field notes are made by participant observation during the recording procedure. Specific attention should be paid to the field, tenor and mode of dicourse as well as to the situational context and children's non-verbal behaviour. The field notes can later be added to the transcripts made from the recorded discourse. All this facilitates an in-depth analysis of the discourse and its context.

The advantages of the functional analysis system can be found in that the method focuses on linguistic units and does not use time as a basic unit of coding. This means that the actual coding of the functions from peer discourse takes place retrospectively from recordings and transcripts - not during the actual data collection procedure. The procedure of re-listening to recordings and re-reading transcripts makes it easier to understand the contextual features from the discourse and consequently helps in identifying functions for which talk is used in the course of cooperative problem solving.

The functional analysis system is also comprehensive. The functions in the method appear to relate to their exponents in the data, facilitating replicable and clear classification and, hence, making detailed descriptions of the nature of pupil talk in diverse contexts possible. It is obvious that there will be problems of interpretation and marginal choices in the process of coding the functions, but that appears to be common to all classification systems designed to understand data as complex as classroom discourse (Coulthard, Montgomery, & Brazil, 1981). An added advantage of the functional analysis system is also the fact that the method is able to provide both qualitative and quantitative data on the nature of pupil talk. This makes the comparison of the nature of peer discourse in diverse learning contexts possible, without reducing the contextual sensitivity of the research findings.

The shortcomings of this method can, on the other hand, be found in that it easily limits the scale of the research into a small study. This obviously decreases the generalisability of the findings. Since verbal interaction is such rich data, it also is likely that some of the

functions for which talk is used in the course of problem solving may go unnoticed or be misunderstood. It is possible that audio recording and observation alone may not provide enough detailed information to enable a full understanding of the discourse and its functions. One way to increase the validity of the use of the functional analysis system to examine peer discourse could be to change research methods in data collection. A video record of cooperative working processes might give deeper insights into children's non-verbal behaviour and the situational contexts in which talk is produced. Informal interviews or thinking aloud protocols stimulated by video-record shown to the pupils after the completion of a task might also bring further information about the functions and meanings peer discourse carries during problem solving. How to overcome the limitations currently identified in the functional analysis system remain among the future developments of the method.

Research applications

There seem to be a number of possible research applications of the functional analysis system. These include the following:

1. Cross-cultural studies of verbal interaction patterns in a variety of classrooms and curriculum areas. For example: - Is peer discourse during the process of collaborative writing with computers patterned in different ways in different cultural settings? - How does the use of computers affect the nature of peer discourse during collaborative writing? - How are interaction patterns affected by variables such as group size and composition, teacher role, the nature of the task and the perception of it by the participants, the curriculum area location of instances of collaborative work?

2. The relationships between particular verbal interaction patterns and writing/learning processes. For example: - How does peer discourse reflect children's writing processes? - Do particular patterns of peer discourse tend to be associated with higher levels of recall of content? - How does the quality of peer discourse relate to the quality of writing in the computer context? - Are different learning outcomes, for example, transferable understanding, more likely to be associated with different verbal interaction patterns?

3. Investigations of the linguistic contexts and patterns of particular talk functions. For example: - What kinds of contexts are more likely to be associated with, say, External Thinking or Argumentational talk? - How does writing genre affect the nature of peer discourse in collaborative writing with computers?

These questions are undoubtedly of importance, not merely to educational theorists, but also to practitioners. At the moment, answers to them are very difficult to obtain, largely because we lack appropriate analytical tools. It is hoped that the functional analysis system outlined in this paper may be of significant value in providing such a tool.

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